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Abstract of the national paper of Slovakia

I. The Slovak space mission to the Mir Space Station

1. From 20 to 28 February 1999, a short-term space flight of the first Slovak astronaut, Ivan Bella, took place during a Russian/French/Slovak mission. The programme of the Slovak space mission was named after M. R. Stefanik, the outstanding Slovak scientist in astronomy, politician and French general (1880-1919). The first Slovak astronaut carried out a research programme in space physics and the life sciences prepared by institutes of the Slovak Academy of Sciences. Since space flight takes place under unique conditions of environmental stresses to the neuroendocrine system (absence of gravity, one of the fundamental forces that shapes life on Earth), the study of the responses to those stresses can provide new insight into neuroendocrine regulation and behaviour. The overall goals of life science observation was therefore to use the unique environment of space flight to study the response of the human organism to specific stresses, to increase understanding of the mechanisms responsible for the neuroendocrine, developmental and behavioural changes that occur in space flight, to obtain new data to enhance human space flight and to apply the results of space research for the health, well-being and economic benefit of people on Earth.

2. On the station Mir, four experimental projects were carried out, dosimetry (in space physics) and endotest, senso-asymetria and quail (in the life sciences). The dosimetry project was devoted to the study of cosmic rays and energy particles in the orbit of Mir. In the first part, passive track detectors (passive detectors of cosmic ray nuclei) were exposed during the mission and evaluation of linear energy transfer and cosmic ray composition was studied.

3. The aim of the endotest project was an investigation of the responses of the neuro-endocrine and physiological functions of astronauts to various types of stress load during space flight, evaluation of the degree of "stressogenic" influence of space flight on working capacity and measurement of the functional reserves of the endocrine system when faced with rapid and unpredictable stressogenic situations during space flight, especially of long duration. For this project, the special new Plasma-03 appliance was used for the collection of human blood, for its centrifugation and the freezing of blood samples and for their transport to Earth for analysis. Those analyses are now being performed at the Institute of Experimental Endocrinology of the Slovak Academy of Sciences.

4. The aim of the senso-asymetria project, designed by the Institute of Normal and Pathological Physiology, Slovak Academy of Sciences, was an investigation of the effects of asymmetric activity of sensory impulses (vestibular or proprioceptive) and an involvement of

that activity in the development of kinetosis and orientation illusions during space flight and the readaptation period after space flight. A preliminary analysis of the results of observations performed before, during and after space flight on the Slovak astronaut showed a successful process of adaptation of the vestibular system to microgravity.

5. The aim of the quail project was to assess the effects of the defined intensity of gravity on the early post-embryonic development of Japanese quail aboard the orbital station Mir. The bird is seen as an element of the closed ecological and alimentary system and it is very important as a source of food for human beings during space flight of long duration. A question arising from a series of previous experiments was how to provide conditions for the survival and normal development of quail during the first days of post-embryonic development. It was decided to solve this problem by using artificial gravity produced by a special centrifuge on board Mir. The bio-material obtained was recently analysed using microbiological, biochemical and morphological methods at the Institute of Animal Biochemistry and Genetics of the Slovak Academy of Sciences. The final summarized results can be expected at the end of 1999 and will be published in scientific journals.

6. During the space mission, two ground projects, concerning training and metabolism, were also performed. The aim of the training project was investigation of the effects of endurance training of astronauts during the pre-flight period on their neuroendocrine and cardiovascular responses to various stress stimuli. The aim of the metabolism project was to study the metabolic consequences of decrease in the physical activity of astronauts during space flight and in subjects during simulated microgravity on Earth.

7. The results obtained in the two projects should help determine optimal pre-flight training for astronauts and some consequences of limited physical activity during space flight from the point of view of neuroendocrine regulation of body function.

II. Space physics, geophysics and astronomy

8. Activities in these areas are devoted to the study of physical phenomena at the surface of the Sun, in interplanetary space and in the magnetosphere, atmosphere and ionosphere of Earth, as well as to cometary explorations. The traditional tools of such research are cosmic rays, energy particles in space, space plasma and interplanetary matter.

9. Energy particles have been studied systematically using the databases from the Interball-1 and 2, and Magion-4 and 5 instruments developed at the Institute of Experimental Physics of the Slovak Academy of Sciences in Košice in international collaboration. This analysis provided new results relevant to the understanding of dynamic processes in the magnetosphere, in the magnetosheath and upstream from the bow shock. Statistical studies of particle populations are continuing, using data from the Interball and Prognoz-10 projects. Low-altitude active (IK24) measurements have shown the short-duration (tenths of a second) pulsations of energy electrons precipitating into the atmosphere. Detailed maps of gamma ray distribution at 500 km altitude have been obtained from Coronas-I measurements.

10. Energy particle monitoring devices have been developed for the two projects planned for low-altitude missions.

11. Cosmic ray studies are based on the Lomnicky Stit massif in the High Tatry mountains, where neutron monitor measurements are continuing. The possibility of using cosmic ray variability as one of the parameters for prediction of geomagnetic variability is currently being analysed.

12. Solar wind parameters from satellite measurements have been analysed in relation to ring current energization during storms.

13. Data on coronal mass ejections show a close relationship with the occurrence of type II radio bursts and long-duration solar events.

14. Changes in climate from 1871 to 1995 have been studied in terms of variable solar forcing, based on data from the Hurbanovo meteorological station.

15. Studies of the lower ionosphere and middle atmosphere have focused on chemical composition, dynamics and appropriate solar effects using experimental data.

16. Non-linear features of solar activity represented by the Wolf sunspot number and sunspot area have been analysed using the concept of self-organized criticality. The existence of 60-year cycles of solar activity has been confirmed.

17. Only a few selected areas of research are mentioned here. A list of papers where the results are summarized and more specific details are given can be found in the biennial national reports of Slovakia to the Committee on Space Research.

III. Life sciences

18. At the Institute of Animal Biochemistry and Genetics of the Slovak Academy of Sciences in Ivanka pri Dunaji, a model experiment involving insemination of Japanese quail during hypodynamy has shown that the efficiency of insemination depends on its frequency. In comparison with natural mating, the efficiency was 62.8 per cent lower after two successive inseminations and 41.7 per cent after three successive inseminations performed over the 22 days of the hypodynamy experiment. The volume of ejaculate, sperm concentration and testosterone levels in males decreased after 15 days of hypodynamy.

19. A joint experiment with American scientists was carried out aboard the Mir orbital station in 1996 using an innovative module of the Incubator-2 device. In that experiment, on days 14 and 16 of incubation 9 embryos were identified out of 20 fixated eggs.

IV. Meteorology

20. The Slovak Hydrometeorological Institute uses data from geostationary meteorological satellites (GMS) mainly in operational practice. Images from the Meteosat-6 and 7 satellites (taken at intervals of 30 minutes) are received and processed on a regular basis. Images from other geostationary satellites (GOES-8 and 9, GMS and Meteosat-5) are received and processed on an occasional basis. Imagery that shows cloud fields over Europe and adjacent areas of the Atlantic in three spectral bands is used for weather analyses and forecasting in the form of animation sequences or of individual images. Individual images are often combined with other meteorological information such as zones of temperature, humidity, pressure and precipitation and can also be used as input to numerical weather prediction models. Expert findings are included in studies of cloud evolution over time, in particular that of cumulus clouds connected with showers and thunderstorms in the central European region. The aim is to distinguish between developing and dissipating phases of clouds. Mean time trajectories in dual-channel diagrams are obtained and used to study the life cycle of clouds and to estimate phases of cloud development.

21. Remote sensing activities have been carried out over the last two years mainly in the following institutes in Slovakia: the Institute of Geography of the Slovak Academy of Sciences in Bratislava; the Forest Research Institute in Zvolen; the Slovak Environmental Agency in Banská Bystrica; and the Faculty of Electrical Engineering and Informatics, Technical University of Košice.

22. The main results were obtained within the framework of a number of international projects: Coordination of Information on the Environment (CORINE) Land Cover, the Phare MARS and Environmental-Related Applications (MERA) '92 (with subprojects relating to land degradation mapping and forest ecosystem mapping), the Danube Remote Sensing Demo Project and the research project on computational intelligence tools in image processing carried out jointly by the Technical University of Košice and the University of Minnesota, United States of America. The following results are worth mentioning: the CORINE land cover map of Slovakia on the scale of 1:500 000; maps of potential and actual risks of soil erosion in Slovakia on the scale of 1:250 000; map of the distribution of tree species in Slovakia; and application of a model to determine the eutrofication risk in water in the river Hron catchment area using remote sensing and Geographic Information System technologies.